

**WHAT IS CLAIMED IS:**

1. A method for the direct execution of an XML-document, comprising:
  - defining the local behavior and process for each element of the XML-document;
  - 5 integrating executable instructions with at least one XML-document or a document type definition (DTD); and
  - storing intermediate states of the execution process by dynamically creating and redefining element attributes.
- 10 2. The method according to claim 1, further comprising:
  - (a) integrating executable instructions by defining for each XML-element definition and its instances an action made up of executable actions, and actions which are references to either the action defined for one of the components of the element or to an action defined for any other element of the XML document; and
  - 15 (b) executing an XML-document by executing the action defined for the root of the XML document.
3. The method according to claim 1, further comprising:
  - defining a composition of the action for at least one XML-element definition or
  - 20 instance by graphical flow charts.
4. The method according to claim 1, further comprising:
  - defining the composition of the action for at least one XML-element definition or
  - instance in textual form.
- 25 5. The method according to claim 1, further comprising:
  - representing system states in terms of n-dimensional data cubes;
  - providing an open interface by making the n-dimensional cubes readable and writeable for other programming and database systems; and
  - 30 making data structures and functionalities of other programming and database systems accessible using executable instructions.
6. The method according to claim 1, further comprising modules that define a process for each element, where the modules are valid with respect to the following DTD:

<!element module (derived\*, expression?, state\*, module\*)>  
 <!attlist module  
                     name CDATA #REQUIRED  
                     number CDATA "1">  
 <!element derived (argument\*, expression)>  
 5 <!attlist derived name CDATA>  
 <!element argument EMPTY>  
 <!attlist argument name CDATA>  
 <!element state (action\*, transition\*)>  
 <!attlist state name CDATA>  
 10 <!element transition (expression, path)>  
 <!element path (component\*)>  
 <!attlist path state CDATA "initial">  
 <!element component (component\*)>  
 <!attlist component  
 15                      name CDATA #REQUIRED  
                     number CDATA "1">  
 <!element expression (path | self | src | trg |  
                             evalattr | getfirst | getnext |  
                             parent | root | apply | external |  
                             constant>  
 20 <!element action (setattr | ifthen | forall | external)>  
 <!element src EMPTY>  
 <!element trg EMPTY>  
 <!element self EMPTY>  
 <!element evalattr (expression\*)>  
 25 <!attlist evalattr attribute CDATA #REQUIRED>  
 <!element getfirst (expression\*)>  
 <!attlist getfirst attribute CDATA #REQUIRED>  
 <!element getnext (expression\*)>  
 <!element parent (expression\*)>  
 30 <!element root EMPTY>  
 <!element apply (expression, expression\*)>  
 <!attlist apply op CDATA #REQUIRED>  
 <!element external (expression\*)>  
 <!attlist external name CDATA  
 35 language CDATA >  
 <!element constant EMPTY>  
 <!attlist constant value CDATA #REQUIRED>  
 <!element setattr (expression?, expression\*)>  
 <!attlist setattr attribute CDATA #REQUIRED>  
 40 <!element ifthenelse (expression, action\*)>  
 <!element forall (action\*)>  
 <!attlist forall range CDATA "all-elements"  
 variable CDATA>.

45 7. A system for use with the method according to one of the preceding claims, comprising:  
 a server providing services to at least one client by executing at least parts of a XML-  
 document according to a XML-robot specification sent from the client to the server or a  
 server providing services to at least one client by sending a XML-robot specification and a  
 XML-document to the client, such that said service is provided by executing of at least part of  
 50 the sent document on the client according to the sent XML-robot specification.

8. An apparatus for use with the method according to claim 1, comprising:  
means for receiving from and sending data to a remote computer; means for storing and  
accessing a XML-document; means for integrating the XML-robot specifications with a  
XML-document and means for executing such integrated document.

9. An apparatus for use with the method according to claim 7, comprising means for  
graphical display of XML-robot specifications within an advanced visual integrated  
development environment and means for generating XML-documents representing said  
XML-robot specifications.

10. An apparatus according to claim 8 or 9, further comprising means for examining,  
validating or animating XML-documents or XML-robot specifications.

11. An apparatus for the direct execution of XML documents, comprising:  
means for graphical display of XML-robot specifications within an advanced  
visual integrated development environment; and  
means for generating animations of the execution process.

12. A method for the direct execution of XML documents comprising:  
providing an execution specification including  
a DTD;  
graphical flow charts; and  
transition rules;  
providing an XML document instance including  
an XML document;  
using the DTD to validate the XML document;  
constructing an attributed structure tree;  
decorating the attributed structure tree with the graphical flow charts to create  
a global flow chart; and  
executing the global flow chart according to the transition rules to directly  
execute the XML document.

13. A computer-readable medium having computer-readable instructions for performing a  
method for the direct execution of XML, the method comprising:  
providing an execution specification including  
a DTD;  
graphical flow charts; and  
transition rules;  
providing an XML document instance including  
an XML document;  
using the DTD to validate the XML document;  
constructing an attributed structure tree;  
decorating the attributed structure tree with the graphical flow charts to create  
a global flow chart; and  
executing the global flow chart according to the transition rules to directly  
execute the XML document.

14. A computer-readable medium having computer-readable instructions for performing a  
method for the direct execution of XML-documents, the method comprising:

defining the local behavior and process for each element of a XML-document;  
integrating executable instructions with a document type definition (DTD), an  
XML-document; and  
storing intermediate states by dynamically creating and redefining element  
5 attributes.

15. A system for the execution of an XML document comprising  
an interpreter generator having an input and an output, the input operative to  
receive an XML specification, the interpreter generator operative to produce at the output an  
10 interpreter, the interpreter having an input and an output, the input operative to receive an  
XML document, the interpreter operative to validate the XML document with respect to a  
general DTD and to execute the XML document .

16. A system for the execution of an XML document comprising:  
15 a compiler generator having an input and an output, the input operative to  
receive an XML specification, the compiler generator operative to produce at the output a  
compiler, the compiler having an input and an output, the input operative to receive a XML  
document valid with respect to a general DTD, the compiler operative to produce an  
executable document at the output.

20 17. A system for the execution of an XML document comprising:  
a first interpreter having an input, the input operative to receive a XML  
specification:  
a second interpreter coupled to the first interpreter, the second interpreter  
25 having an input, the input operative to receive a XML document valid with respect to the  
general DTD, the first interpreter starting a process in the second interpreter, the second  
interpreter operative to execute the XML document.

18. A system for the execution of an XML document comprising:  
30 an interpreter having an input, the input operative to receive a XML  
specification, the interpreter operative to interpret the XML specification;  
a compiler coupled to the interpreter, the compiler having an input and an  
output, the input operative to receive an XML document, the interpreter operative to start the  
compiler; the compiler operative to generate an executable XML document on the output.

35 19. A method for the execution of an XML document comprising  
(a) setting a global variable cur to a root reference;  
(b) setting the value of a global variable mod to refer to a module element  
describing the execution behavior of the root;  
40 (c) copying all state and derived elements from the module mod into the  
element cur, setting the attribute origin of all state and derived elements to cur;  
(d) copying the state and derived elements of the sub-modules of module mod  
into the corresponding components of element cur;  
(e) update cur to cur.traverse; and  
45 (f) if cur is undefined then executing the XML document else returning to (a).

20. The method according to claim 19, wherein executing the XML document comprises:  
(i) setting cur to the XML document's root;  
(ii) setting a global variable curstate to initial;

